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1 Design of the opportunistic garbage collector
P. R. Wilson, T. G. Moher
September 1989 **ACM SIGPLAN Notices , Conference proceedings on Object-oriented programming systems, languages and applications OOPSLA '89**, Volume 24 Issue 10
Publisher: ACM Press
Full text available: pdf(1.33 MB) Additional Information: full citation, abstract, references, citings, index terms

The Opportunistic Garbage Collector (OGC) is a generational garbage collector for stock hardware and operating systems. While incorporating important features of previous systems, the OGC includes several innovations. A new bucket brigade heap organization supports advancement thresholds between one and two scavenges, using only two or three spaces per generation, and without requiring per-object counts. Opportunistic scavenging decouples scavenging from th ...

2 Garbage collection using a dynamic threatening boundary
David A. Barrett, Benjamin G. Zorn
June 1995 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1995 conference on Programming language design and implementation PLDI '95**, Volume 30 Issue 6
Publisher: ACM Press
Full text available: pdf(1.30 MB) Additional Information: full citation, abstract, references, citings, index terms

Generational techniques have been very successful in reducing the impact of garbage collection algorithms upon the performance of programs. However, all generational algorithms occasionally promote objects that later become garbage, resulting in an accumulation of garbage in older generations. Reclaiming this tenured garbage without resorting to collecting the entire heap is a difficult problem. In this paper, we describe a mechanism that extends existing generational colle ...

3 Garbage collecting the Internet: a survey of distributed garbage collection
Saleh E. Abdullahi, Graem A. Ringwood
September 1998 **ACM Computing Surveys (CSUR)**, Volume 30 Issue 3
Publisher: ACM Press
Full text available: pdf(337.65 KB) Additional Information: full citation, abstract, references, citings, index terms, review

Internet programming languages such as Java present new challenges to garbage-collection design. The spectrum of garbage-collection schema for linked structures distributed over a network are reviewed here. Distributed garbage collectors are classified first because they evolved from single-address-space collectors. This taxonomy is used as a framework to explore distribution issues: locality of action, communication overhead and indeterministic communication latency.

Keywords: automatic storage reclamation, distributed, distributed file systems, distributed memories, distributed object-oriented management, memory management, network communication, object-oriented databases, reference counting

4 An experimental study of renewal-older-first garbage collection
Lars T. Hansen, William D. Clinger
September 2002 **ACM SIGPLAN Notices , Proceedings of the seventh ACM SIGPLAN international conference on Functional programming ICFP '0 2**, Volume 37 Issue 9
Publisher: ACM Press
Full text available: pdf(143.87 KB) Additional Information: full citation, abstract, references, citings, index terms

Generational collection has improved the efficiency of garbage collection in fast-allocating programs by focusing on collecting young garbage, but has done little to reduce the cost of collecting a heap containing large amounts of older data. A new generational technique, older-first collection, shows promise in its ability to manage older data.This paper reports on an implementation study that compared two older-first collectors to traditional (younger-first) generational collectors. One of the ...

Keywords: generational garbage collection, older-first

5 Age-based garbage collection
Darko Stefanović, Kathryn S. McKinley, J. Eliot B. Moss
October 1999 **ACM SIGPLAN Notices , Proceedings of the 14th ACM SIGPLAN conference on Object-oriented programming, systems, languages, and applications OOPSLA '99**, Volume 34 Issue 10
Publisher: ACM Press
Full text available: pdf(1.47 MB) Additional Information: full citation, abstract, references, citings, index terms

Modern generational garbage collectors look for garbage among the young objects, because they have high mortality; however, these objects include the very youngest objects, which clearly are still live. We introduce new garbage collection algorithms, called age-based, some of which postpone consideration of the youngest objects. Collecting less than the whole heap requires write barrier mechanisms to track pointers into the collected region. We describe her ...

Keywords: garbage collection, generational and copy collection, object behavior, write barrier

6 Generational garbage collection for Haskell
Patrick M. Sansom, Simon L. Peyton Jones
July 1993 **Proceedings of the conference on Functional programming languages and computer architecture**
Publisher: ACM Press
Full text available: pdf(1.20 MB) Additional Information: full citation, references, citings, index terms

7 Parallel generational garbage collection
Ravi Sharma, Mary Lou Soffa
November 1991 **ACM SIGPLAN Notices , Conference proceedings on Object-oriented programming systems, languages, and applications OOPSLA '91**, Volume 26 Issue 11
Publisher: ACM Press
Full text available: pdf(1.98 MB) Additional Information: full citation, references, citings, index terms

8 Caching considerations for generational garbage collection
Paul R. Wilson, Michael S. Lam, Thomas G. Moher
January 1992 **ACM SIGPLAN Lisp Pointers , Proceedings of the 1992 ACM conference on LISP and functional programming LFP '92**, Volume V Issue 1
Publisher: ACM Press
Full text available: pdf(1.09 MB) Additional Information: full citation, references, citings, index terms

9 Effective "static-graph" reorganization to improve locality in garbage-collected systems
Paul R. Wilson, Michael S. Lam, Thomas G. Moher
May 1991 **ACM SIGPLAN Notices , Proceedings of the ACM SIGPLAN 1991 conference on Programming language design and implementation PLDI '91**, Volume 26 Issue 6
Publisher: ACM Press
Full text available: pdf(1.31 MB) Additional Information: full citation, references, citings, index terms

10 Connectivity-based garbage collection
Martin Hirzel, Amer Diwan, Matthew Hertz
October 2003 **ACM SIGPLAN Notices , Proceedings of the 18th annual ACM SIGPLAN conference on Object-oriented programing, systems, languages, and applications OOPSLA '03**, Volume 38 Issue 11
Publisher: ACM Press
Full text available: pdf(521.65 KB) Additional Information: full citation, abstract, references, citings, index terms

We introduce a new family of connectivity-based garbage collectors (Cbgc) that are based on potential object-connectivity properties. The key feature of these collectors is that the placement of objects into partitions is determined by performing one of several forms of connectivity analyses on the program. This enables partial garbage collections, as in generational collectors, but without the need for any write barrier.The contributions of this paper are 1) a novel family of garbage c ...

Keywords: connectivity based garbage collection

11 Characterization of object behaviour in Standard ML of New Jersey
Darko Stefanovic, J. Eliot B. Moss
July 1994 **ACM SIGPLAN Lisp Pointers , Proceedings of the 1994 ACM conference on LISP and functional programming LFP '94**, Volume VII Issue 3
Publisher: ACM Press
Full text available: Additional Information: full citation, abstract, references, citings, index

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We describe a method of measuring lifetime characteristics of heap objects, and discuss ways in which such quantitative object behaviour measurements can help improve language implementations, especially garbage collection performance. For Standard ML of New Jersey, we find that certain primary aspects of object behaviour are qualitatively the same across benchmark programs, in particular the rapid object decay. We show that the heap-only allocation implementation model is the cause of this ...

12 Implementation techniques: Barriers: friend or foe?
Stephen M. Blackburn, Antony L. Hosking
October 2004 **Proceedings of the 4th international symposium on Memory management**
Publisher: ACM Press
Full text available: pdf(137.10 KB) Additional Information: full citation, abstract, references, index terms

Modern garbage collectors rely on read and write barriers imposed on heap accesses by the mutator, to keep track of references between different regions of the garbage collected heap, and to synchronize actions of the mutator with those of the collector. It has been a long-standing untested assumption that barriers impose significant overhead to garbage-collected applications. As a result, researchers have devoted effort to development of optimization approaches for elimination of unnecessary ...

Keywords: garbage collection, java, memory management, write barriers

13 Run-time support for distributed sharing in safe languages
Y. Charlie Hu, Weimin Yu, Alan Cox, Dan Wallach, Willy Zwaenepoel
February 2003 **ACM Transactions on Computer Systems (TOCS)**, Volume 21 Issue 1
Publisher: ACM Press
Full text available: pdf(530.12 KB) Additional Information: full citation, abstract, references, index terms

We present a new run-time system that supports object sharing in a distributed system. The key insight in this system is that a handle-based implementation of such a system enables efficient and transparent sharing of data with both fine- and coarse-grained access patterns. In addition, it supports efficient execution of garbage-collected programs. In contrast, conventional distributed shared memory (DSM) systems are limited to providing only one granularity with good performance, and have exper ...

Keywords: Communications, distributed sharing, memory consistency, safe programming languages

14 Using key object opportunism to collect old objects
Barry Hayes
November 1991 **ACM SIGPLAN Notices , Conference proceedings on Object-oriented programming systems, languages, and applications OOPSLA '91**, Volume 26 Issue 11
Publisher: ACM Press
Full text available: pdf(1.38 MB) Additional Information: full citation, references, citings, index terms

15 A comparative performance evaluation of write barrier implementation
Antony L. Hosking, J. Eliot B. Moss, Darko Stefanovic
October 1992 **ACM SIGPLAN Notices , conference proceedi ngs on Object-oriented programming systems, languages, and applications OOPSLA '92**, Volume

27 Issue 10
Publisher: ACM Press
Full text available: pdf(2.48 MB) Additional Information: full citation, references, citings, index terms

16 Some issues and strategies in heap management and memory hierarchies
Paul R. Wilson
January 1991 **ACM SIGPLAN Notices**, Volume 26 Issue 3
Publisher: ACM Press
Full text available: pdf(802.62 KB) Additional Information: full citation, citings, index terms

17 Protection traps and alternatives for memory management of an object-oriented language
Antony L. Hosking, J. Eliot B. Moss
December 1993 **ACM SIGOPS Operating Systems Review , Proceedings of the fourteenth ACM symposium on Operating systems principles SOSP '93**, Volume 27 Issue 5
Publisher: ACM Press
Full text available: pdf(1.48 MB) Additional Information: full citation, abstract, references, citings, index terms

Many operating systems allow user programs to specify the protection level (inaccessible, read-only, read-write) of pages in their virtual memory address space, and to handle any protection violations that may occur. Such page-protection techniques have been exploited by several user-level algorithms for applications including generational garbage collection and persistent stores. Unfortunately, modern hardware has made efficient handling of page protection faults more difficult. Moreover, page- ...

18 A simple bucket-brigade advancement mechanism for generation-bases garbage collection
P. R. Wilson
May 1989 **ACM SIGPLAN Notices**, Volume 24 Issue 5
Publisher: ACM Press
Full text available: pdf(786.73 KB) Additional Information: full citation, citings, index terms

19 Pointer swizzling at page fault time: efficiently supporting huge address spaces on standard hardware
Paul R. Wilson
July 1991 **ACM SIGARCH Computer Architecture News**, Volume 19 Issue 4
Publisher: ACM Press
Full text available: pdf(649.78 KB) Additional Information: full citation, abstract, citings, index terms

We describe a scheme for supporting huge address spaces without the need for long addresses implemented in hardware. Pointers are translated ("swizzled") from a long format to a shorter format (directly supported by normal hardware) at page fault time. No extra hardware is required beyond that normally used by virtual memory systems, and no continual software cost is incurred by presence checks or indirection of pointers.This scheme could be used to fault pages into a normal memory from a persis ...

20 An adaptive tenuring policy for generation scavengers
David Ungar, Frank Jackson

January 1992 **ACM Transactions on Programming Languages and Systems (TOPLAS)**, Volume 14 Issue 1
Publisher: ACM Press

Full text available: pdf(1.74 MB) Additional Information: full citation, abstract, references, citings, index terms, review

One of the more promising automatic storage reclamation techniques, generation scavenging, suffers poor performance if many objects live for a fairly long time and then die. We have investigated the severity of this problem by simulating a two-generation scavenger using traces taken from actual 4-h sessions. There was a wide variation in the sample runs, with garbage-collection overhead ranging from insignificant, during three of the runs, to severe, during a single run. All runs demonstrat ...

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